

WHAT IS CLAIMED IS:

- 1 1. A streptococcal choline binding protein wherein the protein is expressed by  
2 *Streptococcus* and has the following characteristics:
  - 3 a) choline-binding activity; and
  - 4 b) elution from a chromatographic column in the presence of at least  
5 about 10% choline;
  - 6 with the proviso that the streptococcal choline binding protein is not PspA or  
7 autolysin (LytA).
- 1 2. The streptococcal choline binding protein of claim 1, having one or more of  
2 a characteristic selected from the group consisting of:
  - 3 c) inhibiting adherence of the bacteria to host cells;
  - 4 d) being reactive with sera from patients infected or recovering from  
5 infection with the bacteria;
  - 6 e) being reactive with rabbit antisera generated against pneumococcal  
7 proteins isolated from a choline affinity column by elution in at least about  
8 10% choline; and
  - 9 f) being labeled by fluorescein isothiocyanate (FITC) without requiring  
10 streptococcal lysis (*i.e.*, in intact bacteria).
- 1 3. The streptococcal choline binding protein of Claim 1 which is isolated from  
2 *Streptococcus pneumoniae*.
- 1 4. The streptococcal choline binding protein of claim 3 which has an apparent  
2 molecular weight by at least about 10% SDS-PAGE selected from the group  
3 consisting of: 112 kDa, 90 kDa, 84 kDa, 70 kDa, and 50 kDa.

4 5. The streptococcal choline binding protein of Claim 1 which has a partial  
5 amino acid sequence selected from the groups consisting of SEQ ID NOS:1-10,  
6 SEQ ID NO:19, SEQ ID NO:21 and SEQ ID NO: 25.

1 6. The streptococcal choline binding protein of Claim 1 labeled with a  
2 detectable label.

1 7. A streptococcal choline binding protein having an amino acid sequence of  
2 SEQ ID NO:19.

1 8. A streptococcal choline binding protein having an amino acid sequence of  
2 SEQ ID NO:25.

1 9. A vaccine comprising the streptococcal choline binding protein of claim 1  
2 and a pharmaceutically acceptable adjuvant.

1 10. The vaccine of claim 9, further comprising an antigen selected from the  
2 group consisting of:

- 3 a) a different streptococcal choline binding protein;  
4 b) PspA;  
5 c) autolysin (LytA); and  
6 d) any combination of one or more of the foregoing.

1 11. A pharmaceutical composition comprising a streptococcal choline binding  
2 protein of claim 1 and a pharmaceutically acceptable carrier.

1 12. The pharmaceutical composition of claim 11, further comprising an active  
2 ingredient selected from the group consisting of:

- 3 a) PspA or autolysin (LytA);

- 4           b)     an antibiotic;
- 5           c)     an anti-streptococcal choline binding protein vaccine, wherein the
- 6           choline binding protein has the following characteristics:
- 7           i)     choline-binding activity; and
- 8           ii)    elution from a chromatographic column in the presence of at
- 9           least about 10% choline;
- 10          with the proviso that the streptococcal choline binding protein is not PspA or
- 11          autolysin (LytA);
- 12          d)     a steroid; and
- 13          e)     an anti-streptococcal vaccine.

- 1   13.    A purified antibody to a streptococcal choline binding protein which choline
- 2   binding protein has the following characteristics:
- 3          a)     choline-binding activity; and
- 4          b)     elution from a chromatographic column in the presence of at least
- 5          about 10% choline;
- 6          with the proviso that the streptococcal choline binding protein is not PspA or
- 7          autolysin (LytA).

- 1   14.    A monoclonal antibody to the streptococcal choline binding protein of claim
- 2   1.

- 1   15.    An immortal cell line that produces a monoclonal antibody according to
- 2   Claim 14.

- 1   16.    The antibody of Claim 14 labeled with a detectable label.

- 1 17. The antibody of Claim 16 wherein the label is selected from the group  
2 consisting of an enzyme, a chemical which fluoresces, and a radioactive elements.
- 1 18. A pharmaceutical composition comprising an antibody to a choline binding  
2 protein of claim 1 and a pharmaceutically acceptable carrier.
- 1 19. A purified nucleic acid which encodes the streptococcal choline binding  
2 protein of claim 1, or a fragment thereof of at least 15 nucleotides.
- 1 20. The nucleic acid of claim 19 which is a DNA molecule having a nucleotide  
2 sequence selected from the group consisting of:  
3 a) a DNA sequence encoding a polypeptide having sequence as depicted  
4 in SEQ ID NOS:1-10, or 19 or 21 or 25;  
5 b) a DNA sequence that hybridizes to the DNA sequence of (a) under  
6 highly stringent hybridization conditions; and  
7 c) a DNA sequence that encodes an amino acid sequence encoded by  
8 the foregoing DNA sequences of (A) or (B).
- 9 21. A recombinant DNA molecule of claim 20.
- 1 22. The recombinant DNA molecule of claim 21, which has a nucleotide  
2 sequence as depicted in SEQ.ID NO:18 from nucleotide 1 through the stop codon  
3 TAA.
- 1 23. The recombinant DNA molecule of claim 21, which has a nucleotide  
2 sequence as depicted in the coding region of SEQ ID NO: 24.
- 1 24. The recombinant DNA molecule of claim 22, wherein the DNA molecule is  
2 operatively linked to an expression control sequence.

1 25. An oligonucleotide capable of screening for a nucleic acid encoding the  
2 streptococcal choline binding protein in alternate species prepared from the nucleic  
3 acid of claim 19.

1 26. A unicellular host transformed with a recombinant DNA molecule of claim  
2 24.

1 27. A nucleic acid vaccine comprising the recombinant DNA molecule of claim  
2 24.

1 28. A method for detecting the presence of a streptococcal choline binding  
2 protein of claim 1, wherein the streptococcal choline binding protein is measured  
3 by:  
4 a) contacting a sample from in which the presence or activity of the  
5 streptococcal choline binding protein is suspected with an antibody to the  
6 streptococcal choline binding protein under conditions that allow binding of  
7 the streptococcal choline binding protein to the binding partner to occur; and  
8  
9 b) detecting whether binding has occurred between the streptococcal  
10 choline binding protein from the sample and the antibody;  
11 wherein the detection of binding indicates that presence or activity of the  
12 streptococcal choline binding protein in the sample.

1 29. A method for detecting the presence of a bacterium having a gene for a  
2 streptococcal choline binding protein of claim 1, comprising:  
3 a) contacting a sample in which the presence or activity of the  
4 bacterium is suspected with an oligonucleotide which hybridizes to the  
5 streptococcal binding protein gene under conditions that allow specific  
6 hybridization of the oligonucleotide to the gene to occur; and

7           b)     detecting whether hybridization has occurred between the  
8           oligonucleotide and the gene;  
9     wherein the detection of hybridization indicates that presence or activity of the  
10    bacterium in the sample.

1   30.    A method for preventing infection with a bacterium that expresses a  
2   streptococcal choline binding protein comprising administering an immunogenically  
3   effective dose of a vaccine of claim 9 to a subject.

1   31.    A method for preventing infection with a bacterium that expresses a  
2   streptococcal choline binding protein comprising administering an immunogenically  
3   effective dose of a vaccine of claim 27 to a subject.

1   32.    A method for treating infection with a bacterium that expresses a  
2   streptococcal choline binding protein comprising administering a therapeutically  
3   effective dose of a pharmaceutical composition of claim 11 to a subject.

1   33.    A method for treating infection with a bacterium that expresses a  
2   streptococcal choline binding protein comprising administering a therapeutically  
3   effective dose of a pharmaceutical composition of claim 18 to a subject.

1   34.    A pharmaceutical composition comprising an inhibitor of streptococcal  
2   adhesion to fibronectin selected from the group consisting of a peptide of not more  
3   than 15 amino acid residues having the amino acid sequence WQPPRARI (SEQ ID  
4   NO:11), an enolase, and an antibody specific for the amino acid sequence  
5   WQPPRARI.

1   35.    A method for treating infection with a bacterium that expresses a  
2   streptococcal choline binding protein comprising administering a therapeutically  
3   effective dose of a pharmaceutical composition of claim 34 to a subject.

- 1 36. A method for treating infection with a bacterium that expresses a  
2 streptococcal choline binding protein comprising administering a hindered cationic  
3 small molecule that inhibits streptococcal adhesion to fibronectin.
- 1 37. The method according to claim 36 wherein the hindered cationic small  
2 molecule is selected from the group consisting of lysine, choline, and arginine.
- 1 38. The method according to claim 36 wherein the hindered cationic small  
2 molecule inhibits binding of an enolase to fibronectin.
- 1 39. A method for treating infection with a bacterium that expresses a  
2 streptococcal choline binding protein comprising administering pulmonarily an  
3 adhesion inhibitory agent selected from the group consisting of a choline binding  
4 protein having the following characteristics:  
5 a) choline-binding activity; and  
6 b) elution from a chromatographic column in the presence of at least  
7 about 10% choline;  
8 with the proviso that the streptococcal choline binding protein is not PspA or  
9 autolysin (LytA), an antibody to a choline binding protein, an enolase, a hindered  
10 cationic small molecule, the peptide WQPPRARI (SEQ ID NO:11), and an antibody  
11 specific for an epitope having the amino acid sequence WQPPRARI (SEQ ID  
12 NO:11).
- 1 40. The method according to claim 39 wherein the hindered cationic small  
2 molecule is selected from the group consisting of lysine, choline, and arginine.